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STRESS AND HUMAN PERFORMANCE
FINAL REPORT

NAVTRASYSCEN TR86-022

James E. Driskell
Rhonwyn Carson
Patrick J. Moskal*

December 1986

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Military operations, almost by definition, involve high levels of stress. Survival in this hostile environment depends on effective performance. Yet, it is ironic that these times when performance is most crucial are often the times when individuals are under the greatest stress, and when stress-induced decrements are most likely to occur--skilled performance declines, poor decisions are made, and crucial information is ignored.

The effects of stress on task performance, and the mitigation of these effects through training are areas of critical concern to the military. The following research examines human performance under stress, and presents a theoretical model for understanding the determinants and performance consequences of acute stress. Two experiments are reported to substantiate this model. The first examines the determinants of performance stress in a military training setting. A second examines consequences of stress on performance, in a team task environment. Keywords:

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EXECUTIVE SUMMARY

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TABLE OF CONTENTS

INTRODUCTION

Few persons become used to emergency, hazardous, or extreme stress conditions, simply because such situations are rare. For example, military personnel may encounter the extreme hostile environment of chemical warfare defense once in a lifetime. Nuclear power plant workers may be faced with the extreme conditions of a nuclear incident very rarely. Yet, we know the potential for serious error that these type of situations engender; risky decisions are made, skilled performance declines, useful information is ignored (see Foushee, 1984). In these situations, where performance is crucial, personnel must be prepared to operate under hostile extreme stress performance conditions, and we must have the knowledge to design training to accomplish this.

Military operations, almost by definition, involve high levels of stress. Military researchers in World War II concluded that <u>the</u> central fact of combat is danger to life and limb (Williams, 1984). Results from this applied research emphasized the importance of the study of the psychological restrictions inherent in combat task performance. For example, stress effects during the Normandy campaign in World War II were such that,

> "...the soldier was slow-witted; he was slow to comprehend orders, directions, and techniques... Memory defects became so extreme that he could not be counted upon to relay a verbal order." (See Siegel, et al., 1981, p. 13.)

With increasingly complex tasks to be performed in the increasingly "high tech" combat environments of the future, the effects of stress on task performance will become even more consequential.

One major aspect of all training programs--and particularly crucial for training for a high stress, hostile environment such as chemical warfare--is that of building the trainee's confidence to perform, confidence in his equipment, and confidence in other personnel. These are factors which should act to lessen susceptibility to negative stress effects. However, we have no clear understanding of the factors that determine stress, nor of the consequences of stress in specific task environments. Thus, there is little empirical guidance available by which to design training, redesign task procedures, or otherwise intervene to overcome these effects. This suggests that "stress" training that is available, designed largely on intuitive rather than on empirical bases, may not be training effective.

As Chambers (1962) notes in reviewing NASA training efforts, although psychological stress has been clearly recognized as a critical factor in aviation psychology and other areas for many years, no adequate measuring techniques or training procedures exist. In other words, there is no knowledge base on human performance under stress on which to base applied efforts. Wickens notes this shortcoming, stating that very little is known about how the components of human performance are affected by stress. Further, he states that,

"When a system designer wants to know how far 95% of the pilot population can reach, before a control's location is established in the cockpit, the figure is available from a data base on human anthropometry. But when the designer wants to know how much attention narrows when pulling six g's in combat or how the operator's mental model of a computer-based automated system is affected by fatigue, only the fuzziest of answers may at present be provided." (Wickens & Rouse, 1985, p. 6)

In order to design effective training to address performance under stress, it is necessary to have a clear, theoretically based understanding of factors that determine stress reactions, as well as a means for predicting and explaining stress effects. The following research examines the effects of stress on task performance. Relevant research on human performance under stress is reviewed, and a conceptual model is constructed for understanding the determinants and performance consequences of acute stress. Two experiments are conducted to substantiate this model. The first examines the determinants of performance stress in a military training setting. The second examines consequences of stress on performance, in a team task environment.

PERFORMANCE UNDER STRESS

Various stressors have been shown to affect performance. These include crowding (Hayduk, 1983; Schmidt & Keating, 1979), noise (Broadbent, 1978; Poulton, 1978), performance pressure (Baumeister, 1984), workload (Goldstein and Dorfman, 1978), anticipatory threat of shock (Wachtel, 1968) or of

dangerous conditions such as parachuting (Hammerton & Tickner, 1969) or bomb disposal (Rachman, 1982; Cox, Hallam, O'Connor, & Rachman, 1983), combat stress (Williams, 1984), and emergency conditions, such as nuclear power plant incidents or flight emergencies (Foushee, 1984; Krahenbuhl, Marett, & Reid, 1978). Research has been conducted examining diving emergencies (Radloff & Helmreich, 1972), flight emergency training (Dougherty, Houston, & Nicklas, 1957; Smode, Hall, & Meyer, 1966), performance decrements (Berkun, 1964; Kern, 1966), and combat (Kubala & Warnick, 1979). Recent research has been conducted in the area of stress effects on military task performance by American researchers (Burke, 1980; Hogan, Hogan, & Briggs, 1984) as well as Soviet (Solov'yeva, 1981; Simonov & Frolov, 1977).

In these and other studies, a number of measurable effects of stressors have been reported, including the following: physiological arousal such as increased heartbeat, labored breathing, and trembling (Cuthbert, Kristeller, Simons, Hodes, & Lang, 1981), motivational losses (Innes & Allnutt, 1967), redirection of attention and increased errors (Baumeister & Steinhilber, 1984), increased self-monitoring (Carver, Blaney, & Scheier, 1979), stressor afteraffects (Cohen, 1980), cue restriction and narrowing of the perceptive field (Combs & Taylor, 1952; Easterbrook, 1959; Friedman, 1981; Groff, Baron, & Moore, 1983), decreased search behavior (Eysenck, 1976; Streufert & Streufert, 1981), longer reaction time to peripheral cues and decreased vigilance (Wachtel, 1968), performance rigidity (Staw, Sandelands, & Dutton, 1981), effects on social behavior (Cohen, 1980), and lowered immunity to disease (Jemmott & Locke, 1984).

The negative effects of stress on task performance have been a focus of inquiry for years. Marshall (1947) reported in World War II that only a small percentage of combat troops actually fired their weapons during combat engagaments--this is not because they did not possess the ability, but because of situational determinants such as stress. Data show that performance stress considered alone may increase errors on operational procedures threefold (Villoldo & Tarno, 1984). Similarly, Idzikowski and Baddeley (1983) found that the time taken to complete manual tasks doubled under stress conditions. A recent evaluation of a chemical warfare defense field training exercise found that 20% of the participants manifested gross negative psychological reactions, and several to the extent that they could not continue (Brooks, Ebner, Xenakis, & Balson, 1983; similar results are reported by Carter & Cammermeyer, 1985).

The point of this brief review is that the deleterious effects of stress on task performance are well documented and have been examined over a considerable period of time. Beyond this literature, little is known concerning the development of training to reduce the negative performance effects due to extreme task conditions. At best, we know that training can minimize the performance decrements imposed by extreme stress, however, there is little quantitative analysis of training effects or comparisons of training or simulation methods and procedures. In sum, little of a systematic nature is known of the basic processes that govern behavior under extreme stress performance conditions, or of procedures for intervening to improve performance.

The first task of the present research is to develop a conceptual model of human performance under stress. Two experiments are conducted to substantiate the usefulness of this model. The first examines the determinants of performance stress in a military training setting. The second examines consequences of stress on performance in a team task environment.

MODEL DEVELOPMENT

The development of a model of human performance under stress serves two primary purposes. First, it provides a theoretical basis for understanding the determinants and performance consequences of stress. That is, the model identifies the critical factors that determine stress effects, and the process through which they operate. Second, the model provides guidance for the direction of research and for training interventions, by delimiting the variables of interest. The stress model is presented in Figure 1.

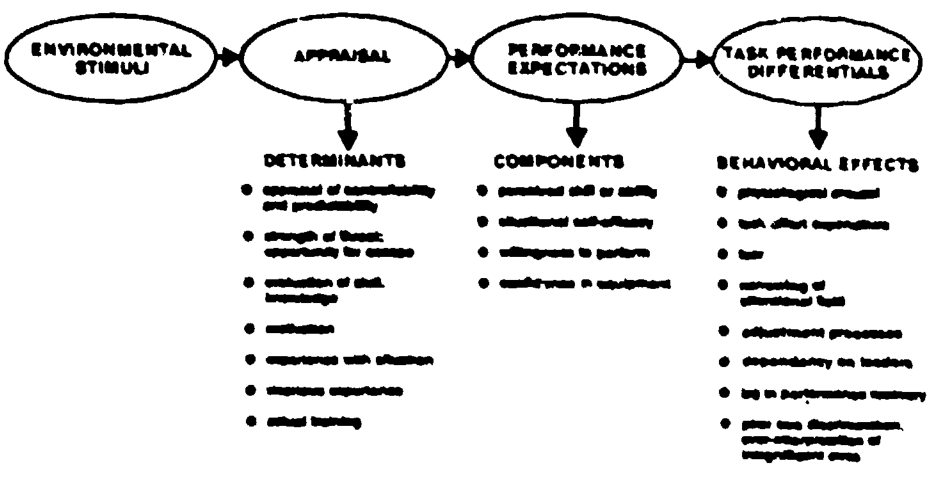


Figure 1: Conceptual model of performance under acute stress.

Two features of the model are of particular significance. First, the model deals with acute stress, defined as an interaction that (1) taxes or exceeds the person's resources and (2) threatens his or her well-being. The present analysis is restricted to acute stress that is sudden, novel, or unexpected, and of relatively short duration. This differentiates this research from work dealing with cumulative, or life stress conditions. Further, analysis is restricted to overload conditions, where demand is greater than ability, thus excluding the effects of stressors such as boredom or sleep loss (although both overload and underload conditions may operate through a similar process; see Harris & Berger, 1983).

Second, a key construct in the model is that of performance expectations. Performance expectations are perceptions of performance ability, which are formed on the basis of the appraisal process, and which determine task performance effects. Thus, performance expectations provide a measurable link between appraisal and behavior.

The process presented in Figure 1 is activated by the introduction of specific environmental stimuli such as noise, an emergency situation, or other potential stressors. The first stage of this model is the activation and operation of the appraisal process. Appraisal is the process of evaluation of a potential stressor situation. A distinction may be drawn between two types of appraisal; primary and secondary appraisal (Folkman, 1984). Primary appraisal involves evaluation of the threat, or of environmental demand. That is, does this situation pose a threat? Secondary appraisal is an evaluation of perceived resources, or ability to meet the demand. Traditional models of

stress presume that appraisal is a function of the degree of discrepancy between demand and ability.

Environmental stimuli become salient, and through the appraisal process, become evaluated either in positive terms (and perhaps seen as a challenge) or in negative terms (and seen as a threat, or stressor). Some of the factors that determine individual appraisal of stimuli are presented in Figure 1, including perceptions of controllability (Thompson, 1981), predictability, (Abbott, Schoen, & Badia, 1984), past experience, and training.

The appraisal process leads to the formation of positive or negative performance expectations. Performance expectations are expectations of successful task completion, or perceptions of future performance. Performance expectations are similar to the concepts of self efficacy (Bandura, 1982), perceived mastery (Pearlin, Lieberman, Meneghan, & Mullan, 1981), and performance confidence (Rachman, 1982). The development of positive performance expectations is a crucial factor in preparing personnel to operate under extreme stress conditions, such as chemical defense operations. An examination of specialized "hazardous duty" training given to British military bomb disposal experts showed that performance confidence improved dramatically from pre to post-training. Further, trainees who developed positive performance expectations reported relatively little fear during operations (Rachman, 1983). Other research has shown this type of performance expectation construct to be a strong predictor of actual performance (Bandura, Reese, & Adams, 1982; Locke, Frederick, Lee & Bobko, 1984).

Performance expectations, in turn, determine the observable task performance differentials of interest. These include physiological, cognitive and emotional consequences such as the stressor effects noted earlier. These performance effects, however, are mediated by a number of factors, such as type of task (simple or complex; Mayer, 1977), (dominant or peripheral; see Easterbrook, 1959; Wilkinson, 1969), severity of stress (Poulton, 1970), presence of others (Friedman, 1981; Groff, Baron, & Moore, 1983), and individual differences (Cooper, 1982).

To relate this process to actual task behavior, it is noted that performance behavior under stress follows a sequential pattern. The first stage is characterized as an initial adaptation to lower levels of stress, and task performance is basically dependent on skill proficiency. The individual is focusing on external task cues, and there is a period of maximum performance effectiveness. As environmental stressors increase, the individual enters a second stage (this stage may be the entry stage for an extreme stressor environment). Stage 2 is characterized by a switch in orientation to an internal focus. The individual's manipulation of the environment becomes less effective; it takes longer to accomplish tasks, and more errors are made. Decline in performance effectiveness is accompanied by an orientation shift from performance cues to threat stimuli. The individual has become increasingly preoccupied with anticipatory damage cues to self, to the neglect of task behavior. Higher levels of stressors increase the level of arousal beyond the optimal level necessary for performance efficiency. A narrowing of attentional focus accompanies the increase in arousal level,

resulting in a restriction of inputs. At lower levels, this reduction and narrowing of attentional span may improve performance by eliminating irrelevant cues. However, as stress level increases, attention is further restricted and task relevant cues are also ignored. Thus, performance is impaired when attentional focus falls below that necessary to process performance cues. A third stage is characterized by a crystallization of the Stage 2 processes. The preoccupation with internal cues and restriction of task cues preempts the ability to manipulate and respond to the external environment, and the individual may act withdrawn, slow to comprehend orders, or preoccupied. By this point, the individual has ceased to make a useful contribution to mission performance.

Obviously, people react to stress in different ways. Progression through these stages is mediated by (1) personality variables, and (2) situational expectations of ability, or situational confidence. Personality traits are less accessible and less amenable to change, and while there are techniques for selection for personality traits, this may not be practical for large-scale military use. However, situational confidence factors are modifiable by training. Situational confidence, reflected in the performance expectation construct in the stress model in Figure 1, involves learned expectations that one can effectively manipulate or control the environment in specific situations. If performance expectations are positive, then the stimulus orientation of an individual in a hostile environment is directed towards external cues associated with controlling or manipulating the environment. If weak, we see evidence of combat stress and mission ineffectiveness. In preparing individuals for

operations in a stressor environment, training must be designed to maximize the performance expectation factor. In this case, for example, military personnel suddenly thrust into a chemical environment will have confidence in their ability and be less prone to performance degradation.

EXPERIMENT 1

The first investigation was a "field test" of the performance stress model described above, to determine its usefulness in examining stress effects in a real-life military setting. The setting examined was the chemical defense training portion of Naval Recruit Training. Of particular interest was the "gas chamber" exercise, a simulation of a chemical environment used to familiarize trainees with this performance environment and build trainee performance confidence.

The research had two goals. The first was to examine the effectiveness of the current chemical simulation training procedure. The second goal was to validate the model of human performance under stress. There are also other, more applied, reasons that warrant examination of Naval Recruit chemical defense training procedures. Over 150 trainees complete this training per day at the Recruit Training Center, Orlando, alone. It provides the only formal training or chemical defense simulation that many receive. Finally, a similar training procedure is used by all military services, so training effectiveness is a substantial issue.

Naval recruit chemical warfare defense training is conducted via a four-hour classroom and hands-on session. The training is conducted in two sequential parts: (a) classroom instruction in which the students receive subject matter information and indoctrination, stressing the importance of attention to training and preparation in the chemical warfare defense area, and (b) a performance confidence exercise involving a hands-on gas chamber simulation. This latter exercise is the procedure of interest here, as the function is to build performance confidence. In this exercise, the trainees don gas masks, enter a gas chamber (contaminated with CS, a riot control or tear gas), and remove the mask before leaving, exposing themselves to the gas. From a standpoint of boosting performance confidence or training for stress conditions, this procedure is of questionable utility, and may lower performance confidence.

The appraisal process (see Figure 1) provides the basis on which positive or negative performance expectations are formed. In examining the determinants of the appraisal process, it appears that these trainees have little control over the environmental stimuli that constitute the threat, lack a basis for predictability of the situation as they have no pre-exposure to the conditions, have little leeway for alternative action or escape, have little skill or experience on which to draw, and the available vicarious cues are negative. Considering these and other factors, it was predicted that rather than building performance confidence, this procedure would achieve the opposite effect. In fact, it seems that this procedure is almost what one would design if their purpose was to <u>lower</u> peformance confidence. It was

hypothesized that performance expectations would decline over the course of this training. Further, in that the gas chamber constitutes a genuinely stressful encounter for most of the recruits, it was possible to examine the effects of performance expectations in determining stress reactions.

Several specific predictions were made. First, in that the model presented identifies the determinants and performance effects of stress, it provides a means for evaluating the effectiveness of training which contains a confidence-building or stress-training component. On the basis of examination of the determinants of stress in the preceding paragraph, it was predicted that performance expectations, a measure of performance confidence, would decline over the course of training. Second, since the model predicts that stress effects are a function of performance expectations, it was predicted that the decline in performance expectations would be accompanied by an increase in reported stress. That is, performance expectations should be a significant predictor of actual stress. Third, the design of the chemical protective mask is such that wearers were not able to wear eyeglasses during the exercise. On the premise that this constitutes a decline in these subjects' ability to control the environment, and in that controllability is one determinant of the appraisal process, it was predicted that those subjects who were deprived of their glasses would form lower performance expectations and report increased stress. Fourth, prior research suggests that the incidence of leaks, or poor seals, with the protective mask may be substantial. Again, it is reasonable to assume that those whose mask did not function properly perceived less control over their surroundings, which would again be reflected in lower performance expectations and greater stress.

METHOD

Subjects. Subjects in this research were 362 male and female recruits at the Recruit Training Center, Orlando, Florida.

Procedure. A quantitative measure of performance expectations was developed to gauge the trainees' perceptions of successful task performance in a chemical defense environment. The resulting questionnaire is comprised of 20 items reflecting four factors: (1) perceived skill or ability at a particular task, (2) situational self-efficacy, or anticipated mastery in a specific situation, (3) willingness to perform in a particular environment, and (4) confidence in equipment, an important factor in reducing fear when there is an equipment interface between the individual and the environment (see Appendix A for complete questionnaire). In addition to the performance expectation measure, the questionnaire included a test of subject matter knowledge as a measure of the success of the classroom portion of training.

The questionnaire was administered to three groups of trainees in three separate conditions to assess their perceptions of successful task performance in a chemical defense environment. In condition 1, a group of trainees completed the questionnaire prior to receiving any chemical warfare training. In condition 2, trainees were given the questionnaire after the classroom portion of training but before the gas simulation exercise. In condition 3, trainees completed the questionnaire at the completion of training.

RESULTS

High correlations among the sub-scales used to measure a construct lend support to their use as a reliable measure of that construct. To assess the internal consistency of the items that comprise the measure of performance expectations, Table 1 presents a correlation matrix for the item scales. The items produce an average inter-item correlation of .4351, lending support to their use as a composite measure of performance expectations.

Table 1. Correlation matrix of composite performance expectation scale items.

	1	2	3	4
1. ABILITY	-	.54*	.44*	.55*
2. SELF-EFFICACY		-	.31*	.44*
3. WILLINGNESS			-	.34*
4. CONFIDENCE IN EQUIPMENT				-

*p<.001

To examine changes in trainee performance expectations over the course of training, Figure 2 presents mean scale scores for the three conditions. The following tests of significance between groups were determined by t-tests. Trainee knowledge scores increased over the period of classroom instruction (p<.001), and remained stable over the course of the simulation exercise. However, as predicted, there was a significant decline in performance expectations as a result of the simulation exercise (p<.001). Note that the decline in performance expectations is not simply attributable to gaining more

information about an adverse performance environment, as expectations did not decline significantly over the course of the classroom instruction. However, as a result of the simulation exercise, performance expectations were lowered to a point where they were <u>less</u> than prior to training.

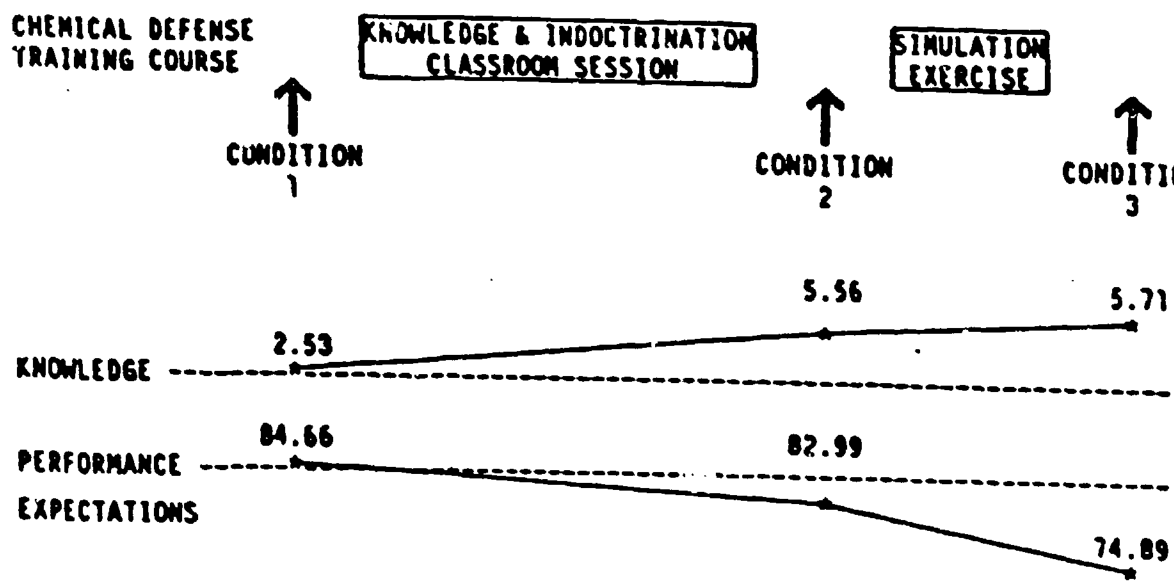


Figure 2. Mean scale scores by condition.

Second, the data indicate that performance expectations are a significant predictor of performance under stress. As shown in Figure 3, those who formed high performance expectations reported significantly less stress during the gas simulation exercise (38.6 vs. 48.9; $p = .029$).

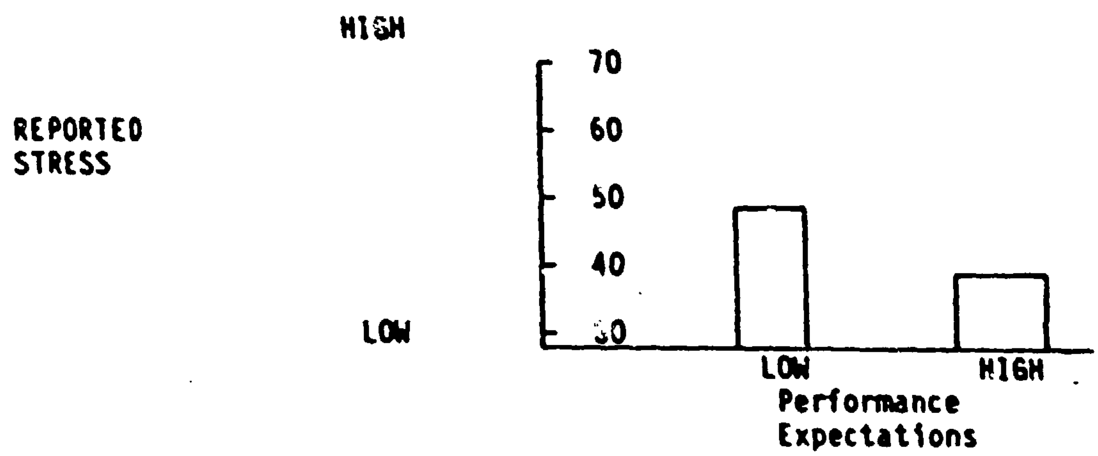
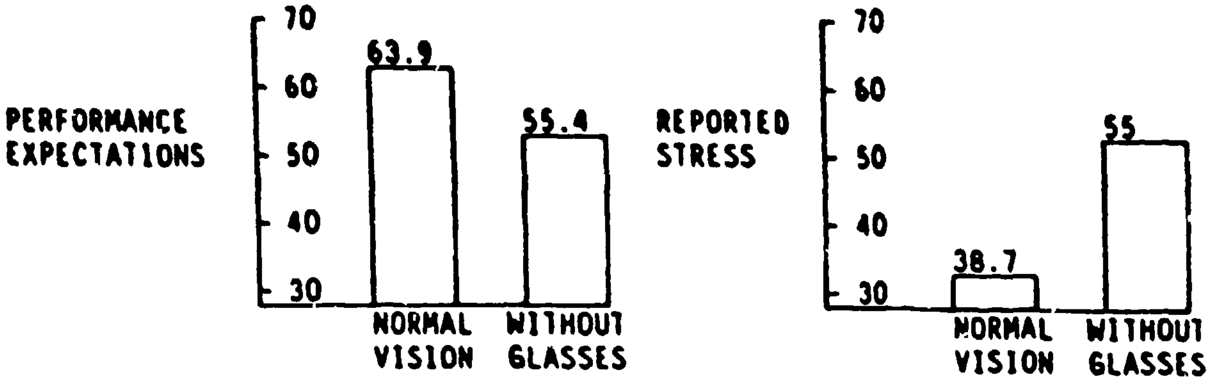


Figure 3. <u>Reported stress as a function of performance expectations</u>.

Figures 4 and 5 examine the effects of loss of controllability on stress. Figure 4 confirms that, as predicted, those who were not able to wear their normal glasses during the simulation exercise formed lower performance expectations ($p=.002$) and reported greater stress ($p<.002$). Finally, Figure 5 confirms that those who complained of a poor mask seal also reported lower performance expectations ($p<.001$) and greater stress ($p=.021$).

<u>Discussion</u>. The present results indicate that placing trainees in a chemical warfare defense training situation with little attempt to allay fears or attend to the determinants of stress reactions will seriously affect



NOTE: Normal Vision subjects were those who were able to see normally during the simulation exercise; i.e., who did not normally wear glasses. The Without Glasses subjects normally wore glasses, but were deprived of them during the exercise.

Figure 4. <u>Changes in performance expectations and reported stress as a function of controllability, via effects on vision</u>.

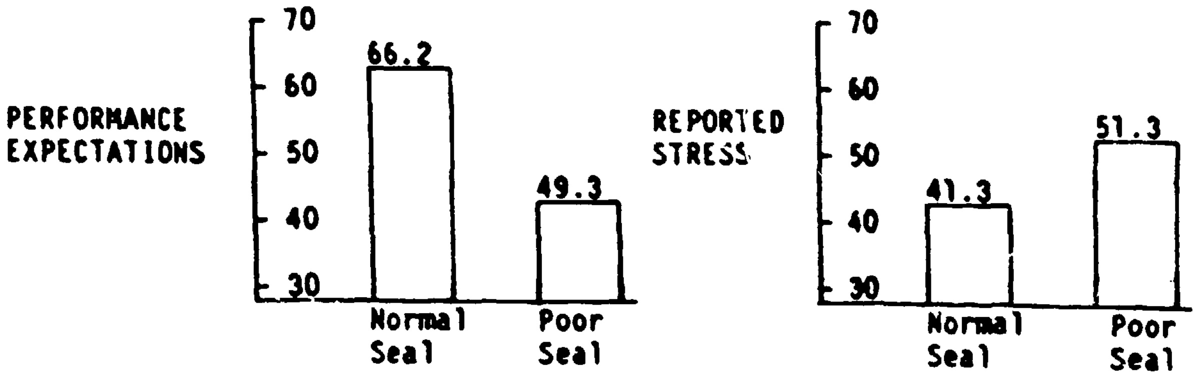


Figure 5. <u>Changes in performance expectations and reported stress as a function of controllability, via equipment failure</u>.

performance. Furthermore, this outcome may affect subsequent behavior in similar situations, where performance is more crucial than in a training environment. Recent research indicates that a negative experience with a stress event increases vulnerability to the impact of a subsequent experience (Goodhart, 1985). This negative training experience may contribute to potential adverse effects during later task performance. Rather than boost performance confidence, present procedures may reinforce that the trainee's initial fears were justified.

A preliminary model of performance under stress has been described, and initial data from an applied field setting support its usefulness. The model provides an effective procedure for evaluating current training effectiveness, and more importantly, provides a basis for implementing and evaluating training improvements. Based on these results, a follow-up research effort is underway to improve the training effectiveness of the recruit chemical simulation exercise.

EXPERIMENT 2

Experiment 1 examined some of the critical determinants of performance stress, observed how these operate in an applied military setting, and, more importantly, developed a usable measure of a trainee's performance expectations formed over the course of a training event. Experiment 2 was designed to examine some specific task-related consequences of performance under stress.

The deleterious effects of stress on human performance are well-documented, and have been a focus of research in psychology for a number of years. A consistent finding in this literature is that stress affects performance in terms of two specific consequences. The first is a restriction of information processing during task performance. For example, individuals working in a multi-task situation under stress tend to maintain performance on central tasks at the expense of peripheral functions (Baddeley, 1972; Combs & Taylor, 1952; Weltman, Smith, & Egstrom, 1971). Easterbrook (1959) concludes that this results from a reduction in the processing of environmental information, representing a shrinkage of the perceptual field; while Cohen (1980) terms this decrease in attentional capacity "cognitive fatigue." Others have provided examples of this restriction in information processing. Wachtel (1968) found that individual performing a tracking task under the threat of shock showed significantly longer reaction time to peripheral stimuli. Wright (1974) found that buyers attended to fewer data dimensions when evaluating the purchase of goods under time pressure. A study from the British Army Staff College showed that early and immediate reactions to battlefield stress include a narrowing of attention and reduced capacity for complex problem-solving (Miles & Philpott, 1982).

This research suggests that in a situation with increasing demands, an individual is simply not able to attend to as many task cues. Individuals tend to dissolve weak links and rely on more accessible or central cues for task completion. This decrease in the range of task cue utilization narrows the peripheral cues processed by the task performer, and the immediate result

is that secondary or peripheral task performance suffers, although the use of central or immediately relevant cues are maintained. Thus, initially one may even observe an improvement in central task performance, or at least a maintenance of proficiency on primary tasks under stress. However, as the threat is maintained or increases or the task becomes more complex, task-relevant cues also become affected. When irrelevant or peripheral cues have been dropped, further reduction in the number of cues processed will affect primary task cues, and overall performance will decline.

A second major process noted in the literature is a constriction of control or authority under stress. Some research suggests that individuals under stress tend to transfer responsibility or yield control more to others (particularly those higher in a group hierarchy). Worchel, Andreoli, and Folger (1977) found that members of groups in competition identified fewer members as leaders than did members of cooperative groups, suggesting a centralization of authority under stress. Exploring organizational dynamics, Staw, Sandelands, and Dutton (1981) concluded that stress resulted in a concentration of control and decision-making rights in higher levels of a hierarchy. They suggest that under such conditions, the task contributions of a dominant member in a group may prevail more readily, and thus influence becomes more centralized. Hamblin (1958) found that individuals in a higher position in a group have greater relative influence during periods of stress. The greater the stress, the greater the compulsion of group members to give power to a central authority (Hook, 1943; Korten, 1962).

At a macro level, Hertzler (1940) observed that larger societal groups are also willing to give away decision-making rights in order to have group performance more effectively coordinated by a central authority. Drawing on historical analysis, Hertzler found that practically every dictatorship examined, from Caesar and Augustus to Cromwell, Richelieu, and Napoleon, was preceded by periods of stress or emergency. In ancient Greece and Rome, constitutional provision was made for the appointment of a dictator in time of crisis or emergency. Today, our own War Powers Act gives the president almost dictatorial powers in the case of war or national emergency. In summary, Hertzler noted that a "mass, in time of crisis is nearly always ready...to give control to anyone who gives evidence of ability to wield it efficiently" (p. 160).

Thus, there are two processes of interest that are a result of performance under stress that may have implications for group interaction: (a) a constriction in control, or increased reliance on group leaders or high status group members, and (b) a restriction of information, or elimination of task cues during interaction. The bulk of research examining these processes has occurred at either the individual level (in the case of restriction of information) or at the organizational or societal level of analysis (research examining centralization of control). There has been little research examining the effects of these processes on group or team performance. However, team tasks, involving the coordination, transmission, and evaluation of multiple task inputs, are estimated to be particularly vulnerable to performance degradation under stress. Performance decrements that occur on

the basis of individual task behavior are multiplied when the unit of analysis is team performance. Furthermore, a majority of critical Navy tasks are performed in a team context. Accordingly, it is of value to examine how these identified stress effects are manifested in team or group performance.

The present research examines the propositions that stress affects group performance by (a) increasing dependency of group members on those in a higher status position in a group hierarchy, and (b) decreasing the utilization of task or performance cues that are normally used to structure group interaction.

METHOD

Subjects. Subjects in this research were volunteer male students from the Basic Electricity and Electronics School, Service School Command, Orlando. A total of 84 subjects were randomly assigned to one of four experimental conditions. Six subjects were excluded from the analysis, leaving 19 subjects in condition 1, 18 subjects in condition 2, 20 subjects in condition 3 and 21 subjects in condition 4. For the six excluded subjects, there was clear and definite failure to meet specified experimental conditions.[1]

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1. Data for these six subjects were excluded for the following reasons: non-collective orientation, i.e., these subjects did not perform as a team member during the data collection task, ($N = 4$); non-task orientation, i.e., these subjects were not concerned with getting the correct answer during the data collection task, ($N = 2$).

Procedure. The design of this research is a variant of the basic experiment developed for studies of status cues and performance expectations (for a more detailed description, see Driskell, 1982; Webster and Driskell, 1983;1985). The experiment required that two subjects work as a team, making a series of binary choices on an ambiguous laboratory task. The sequence of the experiment was as follows.

Subjects were isolated in individual laboratory rooms, and had no initial information on their partner. Each subject's laboratory room contained a television monitor for receiving instructions and experimental information, communications equipment so that subjects could ask questions, a team interaction response panel to register choices on the data collection task, and a camera so the experimenters could monitor subjects during the study. The experimenter's control room contained monitors for viewing each subject and for monitoring experimental procedures, video equipment to transmit experimental procedures to the laboratory rooms, audio equipment to receive and respond to questions, and a microcomputer to record data and control decision-making feedback during data collection. All experimental procedures were presented on closed-circuit videotape.

In the first phase of the experiment, differentiating information was introduced. This information was of two types—either status (which provides descriptive status information on one's partner) or performance (which provides ability or performance information on self and partner). The status

cue used to differentiate subjects was military rank. The performance manipulation consisted of taking, and receiving scores on two laboratory ability tests.

In the second phase of the experiment, subjects worked on a group task. This task required group decision-making on a series of two-pattern checkerboard slides. Each slide contained two rectangular patterns composed of white and black rectangles, as shown in Figure 6. Subjects were instructed to choose the pattern which contained the greater area of white. However, the slides are ambiguous--pretesting has shown that the probability of choosing either alternative pattern is about .50. Therefore, there was no objective basis for making choices on the slides, only the task information introduced in Phase 1.

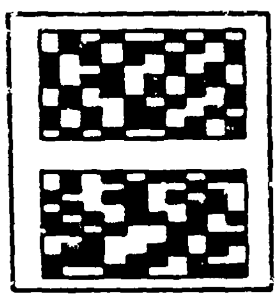

Figure 6. Ambiguous two-pattern contrast sensitivity slide.

Team task behaviors of interest in decision-making can be summarized into the following interaction sequence: (1) an action opportunity, or opportunity to make a task output in a group, (2) a performance output, or problem-solving attempt, (3) evaluation of that output by other group members, (4) agreement or disagreement, and (5) acceptance of output, or resolution in case of disagreement. The team Contrast Sensitivity task was used to simulate this behavioral sequence. Subjects were instructed to make an initial choice on each slide, which was communicated to their partner, to study their partner's initial choice, and then make a final team decision as to the correct answer. So, for each slide, the subject receives an action opportunity, makes a performance output (initial choice), evaluates partner's choice, agrees or disagrees with partner's choice, and makes a final task resolution (final choice).

Most initial choice feedback was experimentally induced disagreements, thus subjects found that they were in near continuous disagreement on each initial choice. Therefore, on each disagreement trial, to make a final choice, a subject may accept influence--take the partner's initial choice as his or her own final choice, or reject the partner's influence--by staying with his or her own initial choice as the final choice. The statistic P(s) is the proportion of stay, or self resolutions made by each subject, a measure of rejection of influence. P(s) is a function of the expectations held for self and other, which are, in turn, formed on the basis of the status and performance information introduced in phase one. Since there was no basis via the task itself to make a task choice (i.e., the task was ambiguous), the P(s)

measure gives an indication of how the subjects utilized the task information presented in phase one to structure the group interaction during decision-making.

Predictions. The experiment consisted of four conditions, differing in the amount and type of information available to the subjects. Table 1 presents the experimental manipulations for each of the conditions.

Table 1. Experimental manipulations.

CONDITION	STATUS CUE	PERFORMANCE CUE	STRESS
1	Low	-	-
2	Low	-	Present
3	Low	High, High	-
4	Low	High, High	Present

The Status Cue is Military Rank. Scores shown are self scores. For example, in condition 1, each subject perceives that he is in a lower position relative to his partner on the military rank variable.

The Performance Cues are Item Discrimination and Meaning Insight (two standard laboratory tests). In conditions 3 and 4, each subject receives two higher performance scores relative to his partner.

In condition 1, subjects were differentiated by a single status cue, military rank. Each subject was introduced to their "partner," a Lieutenant Webster (actually a stimulus person on videotape). Since the subjects themselves were of lower rank, this place them in a low status position relative to their partner. This manipulation should produce a relatively low P(s). That is, subjects should accept more influence (making

fewer self-resolutions on final choices) when paired with a higher ranking partner, than for example, when working with an "equal status" partner. For example, an average P(s) score for a "baseline" condition, when team members are equated on all visible characteristics such as rank, ability, or other task cues, is about .60 (this reflects a slight propensity to stay with one's own choice when resolving disagreements even when there is no differentiating information available on which to base decisions). For comparison purposes, the P(s) in condition 1, in which subjects form low self-expectations relative to their team partner, should be somewhat lower than this figure.

In condition 2, subjects again worked with the higher status partner, but under acute stress performance conditions. Acute stress is defined as interaction that (1) taxes the individual's resources and (2) threatens his or her well-being. To tap both of these components of acute stress, a two-step manipulation was presented. First, subjects were given increased responsibility for the task outcome, so that failure at the task became more consequential (component 1 of the definition). Lazarus (1966) notes that an interaction is appraised as stressful only if the individual judges that something is at stake. Having a greater stake in an outcome provides greater potential for threat. Accordingly, subjects were told in the stress conditions that only <u>their</u> final score would count for the team's score on the task. Their partner's (the Lieutenant's) input was simply to help the subject make a better team choice. Therefore, if they fail, the team fails.

Second, the personal threat component of acute stress was manipulated (component 2). Subjects in the study were Naval technical school students,

most having graduated several weeks before from recruit training. During recruit training, they took part in a tear gas exercise, as part of chemical defense training. This is an exercise familiar to the subjects but viewed as quite aversive, therefore, the group task phase of the experiment was performed under simulated conditions of a tear gas drill. Subjects were told that Navy researchers were interested in how "chemical simulant conditions" degrade performance, so they would perform the Phase 2 task under conditions similar to those they encountered in the recruit exercise. They were to wear the chemical protective mask during the task, and were told that a tear gas simulant would be released so that researchers could evaluate the effects on task performance. (Subjects in the non-stress conditions also wore the mask during Phase 2 in order to equate task conditions, but in this case the situation was defined in more pleasant terms. That is, here we were interested in "how wearing a mask affects task coordination," there was no anticipated tear gas, and subjects were given the control to remove the mask at any time if they so choose.) Post-experimental interviews confirmed that this constituted a plausible and believable manipulation.

If stress conditions do induce an increased reliance on higher status group members, as predicted, this would be reflected by the subjects accepting more influence from their partners during the group decision-making task. That is, subjects would allow the higher status team member to have more influence and make more decisions for the team, resulting in a lower number of self-resolutions on the team task (meaning that when they face a disagreement with their partner on an initial choice, they will keep their own choice as a

final choice less), and a lower P(s) than in condition 1. According to the prediction that stress results in increased dependency of group members on those in a higher status position in a group hierarchy, the predicted ordering of conditions was 2<1.

In condition 3, subjects were differentiated by the status information as in conditions 1 and 2, but also by additional performance cues. Subjects were administered two ambiguous laboratory tests, and were given high scores (relative to their partner) on both tests. Previous research (see Webster and Driskell, 1983) has shown that status as well as performance cues are combined or aggregated as a prerequisite to task interaction. That is, in order to evaluate the task inputs of other team members and achieve a successful solution to the task, team members use all available task information in a situation to evaluate their partner's ability, and to structure the subsequent task interaction. Thus, the additional performance cues provided in condition 3 were expected to be used in this manner--the two high or positive performance cues would be combined with the low-self status cue. This results in the formation of higher performance expectations for self than were formed in condition 1 (on the basis of the low-self status cue alone). These higher expectations should result in a higher rate of self-resolutions (or rejection of influence) during team decision-making, or a higher P(s). On this basis, it is predicted that the P(s) in condition 3 should be greater than in condition 1, or 3>1.

In condition 4, all status and performance manipulations were the same as for condition 3, however, the stress manipulation was again introduced.

Comparison of condition 4 with condition 3 should provide information on how stress affects the utilization of task cues in group decision-making. If stress does operate to restrict task cue utilization, as predicted, this would result in a P(s) in condition 4 less than that in condition 3--the additional task information that is used by subjects in condition 3 would not be fully utilized in condition 4. More importantly, if this additional task information is completely dropped or ignored, and group members structure the task interaction solely on the status characteristic, we will find that condition 4 = condition 1.

RESULTS

Manipulation Check. During the data collection phase of the experiment, subjects in all conditions were monitored for pulse rate, to provide an additional physiological measure as a stress manipulation check. All pulse rate changes between conditions are in the expected direction, with increased pulse rate indicating higher arousal in condition 2 over condition 1, and in condition 4 over condition 3, although these values do not reach statistical significance.

P(s) Data. Table 2 presents the P(s) data for the four conditions, and Table 3 presents the results of the Mann-Whitney U-test of differences between conditions for the predicted comparisons.

Table 2. P(s) data by condition.

Condition	P(s)	σ^2	n
1	.568	7.24	19
2	.411	11.12	18
3	.628	10.66	20
4	.514	20.01	21

NOTE: Variance is calculated about the mean number of stay responses, not P(s).

Table 3. Confidence levels of differences between conditions.

Conditions	Mann-Whitney U	P
2<1	70	<.001
3>1	117.5	<.025
4<3	128.5	.017
1<4	188.5	>.10

NOTE: For the 2<1, 3>1, 4<3, comparisons, one-tailed tests are used; for the comparison of conditions 1 and 4, a two-tailed test is used.

All ordering of conditions are as predicted. Although no predictions are made concerning variance, variance increases from condition 1 to condition 2, and from condition 3 to condition 4, possibly reflecting individual differences in response to the stress manipulation.

Table 3 presents a statistical analysis of differences between conditions. First, the prediction that condition 2<1 was sustained. Thus, the data show that subjects transferred more responsibility for task choices to the higher status group member when the group task was performed under stress. Second, the data affirm that condition 3>1; indicating that the subjects utilized the additional task information provided in condition 3 to structure the group decision-making. Third, the condition 4<3 prediction is sustained; reflecting the reduction in task cue utilization occurring under the stress of condition 4. Finally, there were no significant differences in P(s) between conditions 4 and 1. This implies that the subjects simply ignored the additional performances cues available in the task situation when under stress.

Discussion. The primary goal of this investigation was to evaluate the effects of stress on team performance. This research has taken experimental phenomena normally observed in the province of individual psychology (restriction of information processing) and sociology (constriction of control), and extended the examination of these processes to an area of central interest in terms of Navy task performance, team interaction. In

summary, experimental data reflected changes in both (a) information processes and (b) control processes of group performance under stress.

The first process observed was a concentration of authority or decision-making responsibility in group performance. Thus, the status structure of a group becomes more differentiated under stress conditions--those in a position of influence in the group are given even more influence. From an applied standpoint, this has several implications. There may be positive consequences for group performance in that lines of authority become more demarcated, and in that performance under stress is not the time for more egalitarian decision-making. When control needs to be centralized--when a group has to take critical action under emergency conditions--a strong leardership is beneficial. On the other hand, this over-reliance on group leaders may tax the capability of the leader to coordinate task performance, with a resulting decrement in group task accomplishment.

The second process observed was a decline in task cue utilization under stress. With the increased attentional demands stemming from attention to threat or stress stimuli, group members must economize on cognitive demands. The data show one way this is accomplished in group performance, by restricting the processing of task cues during decision-making.

Further, this study illustrates conditions under which all available task cues are <u>not</u> aggregated in structuring task interaction. A significant

question in social psychology is how individuals process inconsistent information to evaluate the performance competencies of others. A classic example is the case of a male lieutenant interacting with a female commander--is she to be treated in task interaction deferentially as befits her rank, or as a deferential female (female being the lower evaluated state of the status characteristics sex in our culture). This is of considerable practical importance, particularly in the military where a hierarchical rank structure is most evident, and where there are a number of cases of "inconsistent status" (i.e., a high ranking female interacting with a lower ranking male, or a higher ranking Hispanic interacting with a lower ranking white).

Essentially, there are two ways in which individuals may process multiple items of task information. First, individuals may simplify complex situations cognitively by attending to only one cue and using that to order subsequent interaction. In this case, individuals would eliminate all available cues except one. The most advantageous cue for the male in the above example would be sex; so he may attempt to ignore the military rank cue and pattern the following interaction accordingly. In fact, most of the status consistency literature of the 1960's assumed that individuals would follow an elimination procedure in processing inconsistent items of task information, and furthermore, they would try to make their own favorable cues relevant to task interaction.

A second procedure for processing multiple or inconsistent items of task information is called combining. In this case, individuals process all available positive and negative task cues and combine or aggregate them to form composite task expectations. Most of the literature supports a combining process. Most research shows that multiple items of task information are combined; that is, positive and negative task cues are combined or aggregated to form expectations that structure subsequent interaction (as occurred in condition 3). Thus, the female commander would be treated as just that--not given quite the same deference as a male commander, but more than, for example, a female lieutenant (even though the sex or gender characteristic "shouldn't" be relevant). These results do not preclude the possibility that under certain conditions task cues will be ignored. The present research illustrates conditions under which available task cues are eliminated from consideration, and not used to structure task interaction. When groups perform under stress, the data show that some available task cues are ignored. In condition 4, the performance cues were not processed, while the status information was used as a basis for task interaction.

For applied purposes, this process may have significant consequences. In normal team interaction, whether the team is a business team at a board meeting deciding marketing strategy, or a hierarchically structured military team, perceptions of individual competencies and the extent of task participation is determined by all available task cues that a person possesses. Thus, a "high rank female" will occupy a position in task interaction in terms of her negative, but also her positive, task

characteristics. In terms of combining task cues, a high rank female will be allocated more influence on a task above that based solely on the stereotypical evaluation of the sex characteristic. However, the present results suggest that this may not be the case when the task situation involves acute stress. When a decision has to be made under stress or emergency conditions, these additional performance cues may be ignored, with the individual being treated in terms of a single status cue; in this example it may be just "female" or just "black." The implications of this potential loss of task legitimacy may be critical for minority team leaders.

Third, the results have direct implications for Navy combat team performance, and suggest useful direction for training interventions to overcome the task performance decrements that may result during performance under stress. The data suggest a potential overload or over-reliance on team leaders that may occur under operational conditions. The effectiveness of the leader is the single most critical factor in military team performance. The leader not only must coordinate task performance, but also serves as a source of evaluation, as well as inspiration, for others in the group. A well-led group, in addition to outperforming other groups, develops greater cohesiveness and espirit de corps--factors that are critical for performance in hostile military environments. Thus, the leader's effectiveness (or lack of) is manifested in the performance of the group. Research which illuminated where and how team leader decrements may occur is critical.

Data in condition 2 show that team members increase their reliance on team leaders to make decisions when under stress. Since the team leader also has to perform other functions, such as task coordination and executive functions, in certain cases, this may result in overload of the team leader and degraded performance. If this over-reliance of team members on the leader is viewed as an adaptive and functional response on the part of the team members under stress (that is, as an attempt to concentrate power and promote task accomplishments), then simply training the team members to overcome this tendency may not be productive. As an alternative, training may be designed to take advantage of this "strengthening" of the chain of command, with training specified for team leaders to allow them to anticipate and manage this overload.

The observed reduction in task cue utilization also has direct implications for complex tasks that are performed under stress. When faced with threat conditions, individuals tend to focus and restrict-economizing on irrelevant or peripheral task cues, restricting search processes, and responding with well-learned or dominant behaviors. Therefore, the performance of a complex task under stress especially depends on performance-relevant cues being dominant. When information processing is restricted, as the data show, this suggests that only the most accessible or dominant cues are being processed. In such cases, it would be advisable to conduct training for critical tasks on a short-interval schedule, so that performance cues are enhanced periodically. Furthermore, it may be necessary to redesign critical tasks that have to be performed under stress conditions,

to break down complex functions into simpler task elements to ensure a workable task load.

Finally, this experiment has provided a sound empirical setting for the examination of team performance under stress. The experimental situation designed was shown to be believable, efficient, and to provide useful data. Of equal importance, the situation was designed to meet ethical requirements for the consideration of research subjects. Historically, research on stress has been plagued by the difficulty in manipulating stress. Researchers have gone to such extremes as taking subjects up in aircraft, cutting the engine as if to crash, and having the subjects fill out a checklist on the way down (see Berkun, 1964). Others have examined parachuting (Burke, 1980,; Hammerton and Tickner, 1969), or other dangerous situations. The point is that stress is not inherent in a particular situation. As LaPiere noted, "No circumstance, however unusual, is a crisis unless it is so defined by human beings" (1938, p. 438). The present research illustrates that one does not need to go to these environmental extremes to manipulate or observe performance under stress.

SUMMARY

The processes that contribute to the degradation of task performance under acute stress conditions have been examined in both theoretical, laboratory, and field research. A clear understanding of the mechanisms that determine performance degradation under stress is necessary in order to isolate specific

performance effects that may be expected under stress conditions, and to identify effective interventions to lessen these effects.

Research and field observation document a number of cases of decline in performance effectiveness under stress. However, information on the actual changes in task processes that contribute to this decrement is less apparent. The present program has accomplished several tasks. The first is a compilation of relevant literature. While the examination of performance under stress is a scientifically rich area of research, there has been no systematic collection or categorization of research related to training. A second task accomplished is the development of a model of human performance under stress. This model provides a theoretical basis for understanding the determinants and performance consequences of stress conditions. Further, it guides empirical investigations by providing direction for the examination of training interventions. A third accomplishment is the implementation of both applied and experimental research examining performance under stress in specific environments. Finally, this research represents initial efforts to develop a scientific program with general applicability to other applied settings that share the commonalities of extreme stress performance conditions, including emergency flight procedures, explosive ordnance training, nuclear power plant operations, and other military and civilian tasks.

One initial product of this research program was the development of a conceptual model of human performance under stress. The first empirical

research conducted was designed to provide data to evaluate this model, and to examine the determinants of performance stress in a military training setting. The second experiment examined consequences of stress on performance, in a team task environment. A third investigation will examine interventions--how we can overcome these negative effects of stress on team performance. A significant question remaining is how to select and train effective teams that are more resistant, or less vulnerable, to the effects of performance stress.

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The following questions ask for your feelings and impressions about certain topics relating to chemical warfare. We are doing research to find out how recruits, like yourselves, feel about certain matters. Chemical warfare is one area we are concerned with, and it is important that we get a confidential idea of your impressions.

Some of the questions may seem hard to answer, because you probably have not had much experience in these areas. However, it is important for us to understand your feelings and impressions. If your impressions are positive for some of the questions, we would like to know that; and if you have negative impressions, we would like to know that too.

Your answers are strictly private. You will not be asked for your name on the questionnaire.

For each question, try to imagine your impressions of that situation - what you imagine that situation would look like and how you would feel. Then think over the question, and circle the number of the answer that is closest to the way you feel.

1. You are in charge of a team that is performing equipment maintenance topside when your ship comes under attack by nerve gas. Your team is able to put on protective gear, but since your mission is crucial, you are forced to keep working in the presence of the chemical agents.

How well do you think you would be able to concentrate on your duties?

1	2	3	4	5	6	7
Complete attention to job	Strong concentration on job	Moderate concentration on job	Some concentration on job	Slight concentration on job	Very little concentration on job	No concentration on job

2. How interested would you be in entering a rating that would require a large amount of Chemical, Biological, Radiological (CBR) duty in the event of a chemical attack?

1	2	3	4	5	6
Definitely Against Entering	Somewhat Against Entering	Slightly Against Entering	Slight Interest in Entering	Somewhat Interested in Entering	Definitely Interested in Entering

3. You are standing watch topside and your ship has come under full chemical attack. You are wearing protective clothing. How long do you think you could stand watch before you are replaced?

1	2	3	4	5	6	7
10 minutes	20 minutes	30 minutes	40 minutes	1 hour	2 hours	4 hours or longer

4. Would you volunteer for duty that may expose you to chemical weapons?

1	2	3	4	5	6
Would volunteer without reluctance	Would volunteer with very little reluctance	Would volunteer with some reluctance	Would volunteer with much reluctance	Would only volunteer under extreme circumstances	Would not volunteer under any circumstances

5. How at ease do you think you would feel while trying to perform your duties while under chemical attack?

1	2	3	4	5	6
Extremely tense	Very tense	Somewhat tense	Slightly tense	at ease	Very at ease

6. You are a member of a team loading bombs on the flight deck of a carrier that is under chemical attack. How well do you think you would be able to perform your duty?

1	2	3	4	5	6
With extreme difficulty	With much difficulty	With a good bit of difficulty	With some difficulty	With very little difficulty	As well as normal

7. How willing would you be to [illegible]

1	2	3	4	5	6	7
Very willing to accept	Somewhat willing to accept	Less willing to accept	Would accept with some reservations	Would accept with strong reservations	Would accept only in extreme circumstances	Would not be willing under any circumstances

8. Your ship has been attacked with an unknown gas. You are performing duty topside; you hear the alarm, and put on protective clothing. How do you feel these conditions would affect your job performance?

1	2	3	4	5	6
Severe strain on performance	Moderate strain on performance	Some strain on performance	Slight strain on performance	Very little effect on performance	Would not bother performance

9. How sure are you that the chemical protective suit and mask will completely protect you against chemical agents?

1	2	3	4	5	6
Am certain it will give protection	Very certain	Somewhat certain	Somewhat unsure	Very unsure	Am sure it will not give protection

10. You are aboard ship in port and the base has been attacked with unknown chemical agents. A superior asks for volunteers to go out in protective clothing and keep track of the readings on topside chemical agent detection equipment. How would you feel?

1	2	3	4	5	6
Absolutely would not volunteer	Probably would not volunteer	Would lean against volunteering	Would lean towards volunteering	Would probably volunteer	Would be eager to volunteer

11. You are taking part in an amphibious landing. Your job is to conduct chemical decontamination procedures aboard a ship which has been contaminated with chemical agents. You will have to operate in a contaminated environment, identify, and attempt to neutralize the chemical agents.

How confident do you feel you could do the job?

1	2	3	4	5	6
Complete confidence	Very confident	Somewhat confident	Somewhat unsure	Very unsure	Do not think you would be able to do job

12. How confident would you feel if you were to enter a sealed room filled with a vomiting gas while wearing the protective suit and mask?

1	2	3	4	5	6	7
Would enter with complete confidence	Very strong confidence	Much confidence	Some confidence	Slight confidence	Very little confidence	No confidence

13. Imagine what it would be like if you [illegible] words listed below to describe your feelings of having to perform your mission during chemical combat conditions.

Circle the number on each line that shows how you think you would feel. For example, if you think you would feel very calm, you would circle 6 for line A; or if you think you would feel somewhat excited, you would circle 2 . Then you should do the same thing for the next line.

	Very	Somewhat	A little	A little	Somewhat	Very	
A. excited	1	2	3	4	5	6	calm
B. capable	1	2	3	4	5	6	helpless
C. panicky	1	2	3	4	5	6	under control
D. confident	1	2	3	4	5	6	doubtful
E. doomed	1	2	3	4	5	6	safe
F. success	1	2	3	4	5	6	failure
G. hopeless	1	2	3	4	5	6	hopeful
F. clear-thinking	1	2	3	4	5	6	confused

II. The Following Questions Ask You For Information About Chemical Weapons
Please circle the letter of the correct answer.

1. Which of the following is <u>not</u> a type of chemical agent?

   A. Blister Agent
   B. Blood Agent
   C. Radiation Agent
   D. Nerve Agent

2. Which of the following is the correct method for putting on the protective mask?

   A. Chin first.
   B. Head first.
   C. Pull over the head and down with both hands.

3. Which of the following <u>chemical</u> agents can cause severe skin burns?

   A. Radiological Agents
   B. Blood Agents
   C. Blister Agents
   D. Riot control Agents

4. What is the first action you should take when you hear a "GAS" alarm?

   A. Take cover.
   B. Put on the mask.
   C. Continue your mission until directed by superiors.
   D. Administer antidote.

5. When you place your hands over the canister inlets of your mask and breathe in, a properly sealed mask should:

   A. Collapse against your face.
   B. Keep its normal shape.
   C. Allow a small amount of air to enter.
   D. Defog the lens.

6. After you have initially fitted your mask, what is the only adjustment that you should have to make when you put on the mask at a later time?

   A. Adjust center head pad only.
   B. Adjust cheek straps only.
   C. Adjust center head pad and cheek straps.
   D. Adjust canister inlet.

7. The protective mask will provide protection against all of the following, except:

   A. Nerve agents.
   B. Blood agents.
   C. Smoke from fires.
   D. [illegible]ological contamination.

Please circle the appropriate categories.

1. Your age: 17-20 21-24 25-30 over 30

2. Your sex: Male Female